

Austroboletus mutabilis sp. nov. from northern Queensland

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Abstract

Austroboletus mutabilis Halling, Osmundson, & Neves is newly described from dry sclerophyll woodlands on the Atherton Tableland and the Paluma Range of northern Queensland. The diagnostic macroscopic feature that distinguishes this taxon from others in the genus, including sympatric taxa, is the striking colour shift on the pileus from deep red to orange and then yellow. Such a dramatic colour shift is newly described for the genus. The basidiospores possess what appears to be a simple, smooth plage as viewed with light microscopy, but a more complex morphology is revealed when viewed with the scanning electron microscope.

Introduction

Austroboletus appears to be mostly tropical in distribution but taxa are recorded from north temperate regions (Japan and USA), Australasia, as well as Australia, New Caledonia, and New Zealand (Watling & Gregory 1986). Although a coarsely reticulate to lacunose stipe is common on species occurring in western Pacific countries, some, such as *A. gracilis* (Peck) Wolfe, have only a slightly ridged or nearly subglabrous stipe. The spore colour in deposit (vinaceous, porphyry pinkish to lilaceous brown) and conspicuous wall ornamentation are other unifying features of the genus, although the type and degree of ornamentation ranges from scattered isolated pits to meandering fissures with occasional isolated protuberances or there may be obvious solitary wart-like pegs confined to the equator of the fusoid spores. While there have been advances in circumscribing *Austroboletus* and some of its subordinate taxa (Corner 1972 as a subgenus; Wolfe 1979; Horak 1980; Watling & Gregory 1986), none of these papers mention a red austrobolete with a succession of distinctive colour changes.

Below, we describe *Austroboletus mutabilis* as a new species whose pileus exhibits a dramatic colour shift from red through orange to yellow. Microscopically, the suprahilar plage on spores of *A. mutabilis* is conspicuous and appears to lack the obvious ornamentation present on the rest of the spore. While the plage appears smooth under the light microscope, scanning electron micrography shows a large, irregular pit or erosion of that region which seems to develop with maturation. In Wolfe's (1979) compilation of scanning electron micrographs illustrating external spore ultrastructure, no images of taxa portray the intricate detail seen on the suprahilar plage of *A. mutabilis*. The new taxon is currently known from several collections gathered during 1992 in the Paluma Range, and 1992 and 2006 on the Atherton Tableland.

Materials and methods

General colour terms are approximations, and the colour codes (e.g., 7D8) are page, column, and grid designations from Kornerup and Wanscher (1983). All microscopic



Figures 1–2. Habits of *Austroboletus mutabilis*. 1. R. E. Halling 8745 (holotype), $\times 0.75$. 2. R. E. Halling 8768, $\times 0.75$.

structures were observed with an Olympus BHS compound microscope equipped with Nomarski differential interference contrast (DIC) optics, and measured from dried material revived in 3% KOH. The letter abbreviation, Q , refers to the mean length/width ratio measured from n basidiospores, and x , refers to the mean length \times mean width. Fragments of the hymenophore were removed from dried basidiomata, mounted directly on aluminum stubs (EMS#75610) using carbon adhesive tabs (EMS#77825-12), and coated with 10 nm of gold using a Hummer II sputter coater. The basidiospores were examined with a Hitachi S-2700 scanning electron microscope operating at 10KeV. Herbarium acronyms are from Holmgren *et al.* (1990).

Taxonomy

Austroboletus mutabilis Halling, Osmundson & Neves *sp. nov.*

Figs 1–8

A specibus Austroboletorum ubique coloribus pileorum mutabilibus; ut videtur plaga sporarum levi sed vero crasa distinguenda.

Type: Queensland, Mareeba, ± 12 – 15 km E of Kuranda-Mareeba Highway along Davies Creek Road, Davies Creek N.P., $17^{\circ}1'S$, $145^{\circ}35'E$; ± 720 m, 9.ii.2006, R. E. Halling 8745 (holotype BRI; isotype NY).

Pileus (2–)3–6 cm broad, convex or pulvinate to plano-convex, glutinous when young and fresh, soon viscid to subviscid or dry, matted to glabrous beneath the gluten, dark red to brownish red (10B–F8 to 8–9C–D8) when young, soon fading to brownish orange (7B7–5B7 to 7D8), becoming orangish yellow (6C–D8), then eventually yellowish (4A7,6), sometimes with adherent glutinous universal veil remnants at margin. *Flesh* soft, white, unchanging, with mild odor and slightly acidic taste. *Tubes* adnate to adnexed, white at first, soon becoming pale porphyry pinkish brown (7–8C–D5–4), staining brownish yellow when bruised, with *pores* pale pink (7A2) to greyish pink (7B2), staining darker pink or light brown. *Stipe* (4–)6–12 cm long, 5–10(–12) mm broad, equal to slightly broader below, then tapered slightly toward base, dry, white and alveolate-reticulate to lacerate nearly overall, sometimes coarsely so, with ridges slightly finer above and near apex, typically draped (except for apex) with translucent yellow to dull or dark ochraceous to dark honey brown glutinous universal veil remnants, with white, solid interior eventually becoming pithy to slightly hollow, with white basal mycelium. *NH₄OH:* on pileus, immediately grass green on lighter portions; dark green on redder portions, becoming orange at point of application with green halo; negative on flesh; faint pink on glutinous veil that adheres to stipe; negative on stipe surface.

Basidiospores greyish red (9C–D3) to reddish brown (8–9E7) in deposit, 11.9 – 14.7 \times 4.9 – 7 μm , $Q = 2.23$, $n = 20$, $x = 12.9 \times 5.8$ μm , broadly subfusoid to elongate amygdaliform, with wall minutely pitted, eventually more obviously pitted and dissected by short, meandering fissures that occasionally isolate irregular ridges, with a smooth to conspicuously eroded suprahilar plage, cyanophilic, brownish yellow in KOH, inamyloid or sometimes dextrinoid in mass in Melzer's. *Basidia* 25 – 35×10 – 13 μm , 4-sterigmate, clavate, hyaline or sometimes with granular content. *Hymenial cystidia* present as scattered, fusoid to lageniform pleurocystidia and abundant, cylindric to elongate-clavate cheilocystidia, without differentiated contents. *Tube trama* boletoid, diverging from a central zone of brownish yellow hyphae, with lateral elements 5 – 8 μm broad, becoming gelatinized with age. *Pileipellis* a suberect to erect, tangled trichodermium embedded in a gelatinous matrix; hyphae with a pale brownish pigment dissolving in KOH, non-encrusting and amorphous in Melzer's, with terminal elements

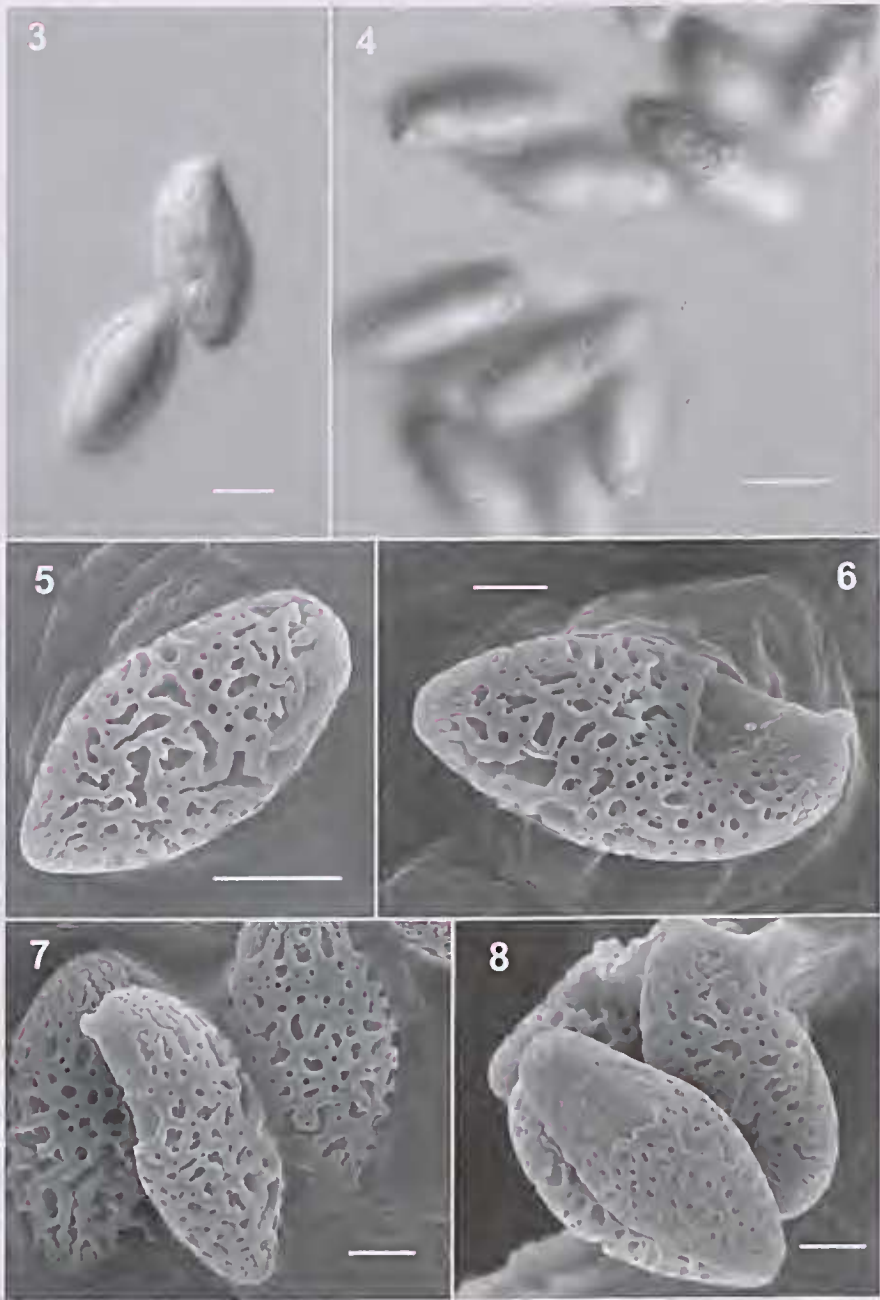
hyaline, smooth and thin-walled, cylindrical to elongate, 3.5–7 μm wide. *Pileus trama* interwoven, hyaline, inamyloid, with elements 5–14 μm wide, smooth, thin-walled. *Stipitipellis* hymeniform, with sphaeropedunculate or short-clavate to elongate clavate caulocystidia, rarely fusoid to sublageniform and projecting. *Stipe trama hyphae* parallel, cylindrical, hyaline, inamyloid. *Clamp connections* absent.

Habit, habitat, and distribution: gregarious to scattered, sometimes solitary, rarely caespitose on coarse, granitic soil in sclerophyll woodlands with *Acacia aulacocarpa* Cunn. ex Benth., *Allocasuarina littoralis* (Salisb.) L. A. S. Johnson, *A. torulosa* (Aiton.) L. A. S. Johnson, *Eucalyptus intermedia* R. Br., and *Xanthostemon* sp. Known from the Paluma Range (Mt. Spee section) north of Townsville and the Atherton Tableland west of Cairns.

Additional specimens examined: QUEENSLAND: ATHERTON: Atherton, Mt. Baldy State Forest, 17°18'32", 145°23'53", 1000 m, 22.ii.2006, *T. W. Osmundson 1144* (BRI, NY). MAREEBA: Mareeba, Davies Creek National Park, Davies Creek Road, 17°1'S, 145°36'E; 650–700 m, 5.ii.1992, *R. E. Halling 6771* (PERTH, NY), 19.ii.1992, *R. E. Halling 6817, 6822, 6835* (PERTH, NY), 4.ii.2006, *R. E. Halling 8732* (BRI, NY), 21.ii.2006, *R. E. Halling 8768* (BRI, NY), *T. W. Osmundson 1139* (BRI, NY). THURINGOWA: Paluma, Paluma Range National Park, 17.ii.1992, *R. E. Halling 6795* (PERTH, NY), 18.ii.1992, *R. E. Halling 6804, 6813* (PERTH, NY).

Discussion: The major distinguishing macroscopic feature of this austrobolete is the dramatic colour shift on the pileus that occurs as the basidiomata age. While this colour shift may occur as a consequence of time, the shift also appears to be mediated by exposure to light and/or fluctuation in humidity. Without exception, the immature or button stages are dark red and pass through an orange stage and eventually become yellow as the basidiomata mature. Intermediate forms can be found that exhibit combinations of these colours and these appear to result from differential exposure to light and air (i.e., one pileus overlaying a portion of another). Because solitary basidiomata are found that may exhibit only one of the colour phases, collectors and naturalists should be aware of this temporal colour change. Also, the pileus is glutinous at first, but becomes viscid to subviscid and then dries out during maturation and with exposure. The gluten extends from the pileus downward and overlays the stipe when young, then dries and shrinks as the basidiomata expand with maturation. The gluten then is distributed in patches or annular zones. With the light microscope, the suprahilar plage appears smooth on spores that are otherwise conspicuously ornamented with pits and fissures. Ultrastructural detail seen with the scanning electron microscope reveals a smooth suprahilar plage on young spores, which then appears eroded at maturity.

Corner's (1972) aquarelle of *Austroboletus mucosus* (Corner) Wolfe illustrates a similar yellowish pileus colour and deposition of glutinous veil remains as on the stipe of *A. mutabilis*, but *A. mucosus* is tawny brown at first (not red) with a white to cream coloured stipe (not entirely white), and produces spores with isolated verrucae (not with meandering ridges and fissures) restricted to the broad, central portion. Sympatric taxa in Davies Creek National Park include *Austroboletus subvirens* (Hongo) Wolfe [several collections, for example, QUEENSLAND: MAREEBA: Mareeba, Davies Creek National Park, Davies Creek Road, 17°1'31"S, 145°35'52"E; 720 m, 21.ii.2006, *R. E. Halling 8772* (BRI, NY)] and *A. lacmosus* (Kuntze) T. W. May & A. E. Wood. The former has a green pileus and stipe ornamentation and the latter is uniformly coloured a cinnamon brown to a light cocoa brown throughout development with a much more complex pattern of reticulation (but not lacerated) on the stipe surface. Other species



Figures 3–8. Spores of *Austroboletus mutabilis* (R. E. Halling 8768). **3.** View with Nomarski DIC, upper right spore with apparent smooth plage in profile, scale bar = 5 μm . **4.** View with Nomarski DIC, spores with apparent smooth plage in adaxial view (bright areas), scale bar = 5 μm . **5.** Abaxial view with SEM, scale bar = 5 μm . **6.** Nearly profile view with SEM; eroded plage, scale bar = 2 μm . **7.** Profile view (centre spore) with SEM; sub-smooth to nearly eroded plage, scale bar = 2 μm . **8.** Adaxial view with SEM; sub-smooth to nearly eroded plage, scale bar = 2 μm .

listed as occurring in Australia (May & Wood 1997), i.e., *A. eburnens*, *A. niveus*, *A. novaezelandiae*, *A. occidentalis*, and *A. subflavidus* do not have red pilei.

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References

- Corner, E.J.H. (1972). *Boletus in Malaysia*. Government Printer, Singapore.
- Holmgren, P.K., Holmgren, N.H. and Barnett, L. (1990). *Index herbariorum. Part 1. The herbaria of the world* (8th edn). The New York Botanical Garden, New York. [<http://www.nybg.org/bsci/ih/>]
- Horak, E. (1980). Supplementary remarks to *Austroboletus* (Corner) Wolfe (Boletaceae). *Sydowia* **33**, 71-87.
- Kornerup, A. and J.H. Wanscher. (1983). *Methuen handbook of colour*. (3rd edn.) Eyre Methuen, Ltd., London.
- May, T.W. and A.E. Wood. (1997). *Catalogue and Bibliography of Australian Macrofungi 1. Basidiomycota p.p.* Fungi of Australia Volume 2A. CSIRO Publishing, Canberra.
- Watling, R. and Gregory, N.M. (1986). Observations on the boletes of the Cooloola Sandmass, Queensland and notes on their distributions in Australia. *Proceedings of the Royal Society of Queensland* **97**, 97-128.
- Wolfe, Jr., C.B. (1979). *Austroboletus* and *Tylopilus* subg. *Porphyrellus*. *Bibliotheca Mycologica* **69**, 1-148.